Surveys of gas plumes off Hokkaido, Sea of Okhotsk

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Gas hydrates (GH) are attracting attention as a future energy resource, with projects aimed at their utilization under way in various countries. In Japan, the MH21 R&D project in the Nankai Trough region has entered its production test stage. On the other hand, in 1995, when Japan pioneered a project for the utilization of GH, clear bottom-simulating reflectors (BSR) were confirmed also at the Kitami-Yamato Bank in the Okhotsk Sea offshore of Abashiri, indicating the possible existence of GH there. In addition to this, seismic survey records collected by the National Institute of Advanced Industrial Science and Technology (AIST) during a cruise for their GH01 project in 2001 also confirmed noticeable BSR.
On the zone which GH exists in stability by temperature and pressure conditions (HSZ: Hydrate Stability Zone), GH existed in the upper part of HSZ is called shallow type GH, and that existed in the lower part is called deep type GH. This deep type GH is observed in a zone immediately above a BSR. Therefore, observation of BSR becomes an index of deep type GH existence. This BSR is confirmed in off Okushiri Island, off Hidaka, off Tokachi and off Abashiri in the around of Hokkaido Island.
On the other hand, shallow type GH is found in sediments of the surface layer or the exposed seafloor. That have been recovered off Abashiri in the Okhotsk Sea in the around of Hokkaido. In the area existed shallow type GH, gas plumes are also observed by echo sounder. Therefore, observation of gas plume becomes an index of shallow type GH existence.
In this study, to clarify the distribution of gas plume off Hokkaido in the Okhotsk Sea, a survey using the Oshoro-Maru, the research training ship of the Hokkaido University, was conducted in November 2015, and analysis of the data of quantitative echo sounder that was acquired in the past by research ships of the Hokkaido Research Organization (ORC). As a result, including past surveys, the number of locations where gas plumes have been confirmed is about 300 in the Okhotsk Sea offshore of Hokkaido.

Keywords: Gas hydrate, Gas plume, Marine sediment

Characteristics of structure I natural gas hydrate encaged thermogenic methane

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Crystallographic structures of natural gas hydrate are usually either structure I or structure II. The latter can encage larger hydrocarbons, for example, propane, isobutane, n-butane, and neopentane. Because the origin of these molecules is thermogenic, methane ascending with them from deeper sediment layer is also thermogenic. Hydrate-bound thermogenic methane has been reported in the world (Gulf of Mexico, offshore Vancouver Island, Caspian Sea, etc.). C1/C2+ of guest gas in these sites are less than 10, indicating that compositions of ethane and propane in hydrate-bound hydrocarbons are in an order of several percent. Therefore, crystallographic structure of gas hydrate composed of thermogenic gas is primarily the cubic structure II.
On the other hand, the structure I gas hydrates retrieved off Joetsu contained thermogenic methane (delta 13C > -50 permil, e.g. Lu et al., 2011). C1/C2+ of hydrate-bound hydrocarbons was more than 2,000, whereas the maximum value of methane delta 13C was -35permil (Hachikubo et al., 2015). It is still unknown how higher hydrocarbons reduced in the sediment. Gas hydrates have been discovered at the southwestern Sakhalin Island in the cruises of LV59 (2012), LV62 (2013), LV67 (2014), and LV70 (2015) on board R/V Akademik M. A. Lavrentyev in the framework of Sakhalin Slope Gas Hydrate (SSGH) project. We reported in the last JpGU meeting that hydrate-bound gas contained 13C-rich methane, suggesting thermogenic origin. In this study, we focus on the gas hydrates of the cubic structure I containing thermogenic methane retrieved from the Tatar Trough, off Sakhalin Island, and compare with those retrieved off Joetsu.
We obtained hydrate crystals from sediment cores, and stored them in liquid nitrogen. Raman spectra of the crystal showed two peaks of C-H stretching mode, correspond to methane molecules in large and small cages of the structure I, and small peaks of hydrogen sulfide were also detected. We also obtained hydrate-bound gas on board and measured their molecular and stable isotope compositions. C1/C2+ of hydrate-bound hydrocarbons ranged between 200 and 800, suggesting that contribution of thermogenic C2+ was low. However, delta 13C and delta D of hydrate-bound methane distributed from -48permil to -42permil and from -200 permil to -170 permil, respectively. According to an empirical classification of the methane stable isotopes (delta 13C and delta D; Whiticar, 1999), hydrate-bound methane obtained at the Tatarsky Trough was mainly thermogenic origin. Characteristics of hydrate-bound methane is similar to those obtained off Joetsu. delta 13C of CO2 in sediment gases was high (+20 permil), suggesting interaction between methane and CO2 through microbial activity.
We appreciate the support of the crew onboard R/V Lavrentyev during the LV59, LV62, LV67, and LV70 cruises off Sakhalin Island. This study was supported by the Grant-in-Aid for Scientific Research (B) 26303021 of the Japan Society for the Promotion of Science (JSPS).
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Keywords: hydrate, methane, Sakhalin Island

Controls of mud diapirism on gas hydrate systems in the Lower Fangliao Basin, offshore southwest Taiwan

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The accretionary wedge of the incipient arc-continent zone of Taiwan has been identified rich in gas hydrates as inferred from reflection seismic data. We employed 2D and 3D seismic data to understand the interplay of structural development, especially mud diapirism, and gas hydrate formation in the Lower Fangliao Basin, a slope basin situated in the upper accretionary wedge. Seismic reflection data show mud tectonics exerts controls on the formation of bottom-simulating reflectors (BSRs) and the distribution of gas hydrates. Mud diapirs can be recognized on seismic profile in terms of acoustically transparent piercement structures. The formation of mud diapirs in the study area is ascribed to overpressured sedimentary layers, compressional tectonic forces, and gas-bearing fluids. The sedimentary strata on both sides of a mud diapir exhibit dragging and onlapping features due to uplifting of the diapir. Both normal strata and growth strata are discernable, suggesting the dynamics of mud diapiric development through time.
The interplay of mud diapirism, sediment dispersal, and regional convergent tectonics to the gas hydrate system is echoed from seismic facies in the study area. Five seismic facies have been observed, including uneven-truncated, stratified-parallel, chaotic-transparent, strong-parallel-reflection, reflection-free facies and are deciphered as seafloor/erosional surface, hemipelagic sediments, mass transport deposits (MTDs), sandy turbidite sediments, and mud diapirs, respectively. The gas hydrate and free-gas zonation within gas hydrate stability zone (GHSZ) is characterized by (1) high amplitude reflections with the analogous phase of seafloor indicating possible porous turbidite sands reservoir; (2) BSRs showing polarity reversal to that of seafloor, suggesting higher impedance gas-hydrate charged sands overlying lower impedance sands with free gas; (3) those strong reflections in the fault zones as gas-bearing fluid conduits; (4) strong reflections on the sides of mud diapirs (e.g. flank drags) and above buried mud diapir demonstrating the presence of gas hydrates, and (5) high amplitude reflections dragging on diapiric flanks with reversal phase of seafloor indicating free-gas charged sands abutting mud diapirs. Vertical venting governed by mud tectonics is the key to inducing thermogenic gas seepages. When such structure is absent, biogenic gas could be the alternative source for free gas or gas hydrate accumulations. Upward mud intrusion contributes to initiation of brittle deformation for deeply buried gas migration pathways. The low-permeability nature of mud diapirs promotes prominent traps for free gas or gas hydrate preservation along the diapiric flank. Due to its high thermal conductivity, active mud diapirs may act as dewatering catalyst for hitherto preserved gas hydrates, allowing dissociated gas to be accumulated, even within GHSZ.

Keywords: gas hydrates, mud diapirs, seismic reflection, accretionary wedge, Taiwan

Resource assessment of shallow gas hydrate of Japan Sea: Overview and Preliminary Results of 2013-2015 METI Project

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It had been well documented that shallow gas hydrates occur as a nodular to bedded form of a few cm to a few meters in the hydrate mound, the upper part of gas chimney structure (acoustic blanking zone) along the eastern margin of Japan Sea (e.g., Matsumoto et al., 2005, 2012). On the basis of the Basic Act on Ocean Policy (approved by the Cabinet on April 2013), METI launched 3 years project to assess the resource potential of the shallow gas hydrates in Japan Sea. Gas hydrate laboratory of MU has conducted a regional bathymetric and geologic survey, drilling survey, environmental assessment survey etc. as AIST's sub-commissioned project. Regional survey has focused on regional mapping of potential hydrate-bearing structures by means of MBES and SBP systems along the eastern margin of Japan Sea and around Hokkaido Island, and confirmed 1742 hydrate mounds with gas chimney in 3 years. LWD drilling and pressure coring on selected hydrate mounds and gas chimneys successfully identified gas hydrate concentration zones characterized by high sonic velocity, high resistivity, low natural gamma ray etc, and finally recovered hydrate-bearing sediments including more than several meters thick, massive and bedded pure gas hydrates for the first time in the world. A number of ROV dives observed sea floor manifestations of methane seeps, outcrops of a few meter thick hydrate beds and crater-like depressions formed by a collapse of massive hydrates. Long term monitoring of benthic environments have been also performed under this project. Preliminary results as to the resource assessment will be discussed in the presentation. This study was conducted as a part of the shallow methane hydrate exploration project of METI. We express sincere thanks to personnel from the AIST, JOGMEC and allied Universities and Institutes for their participation in long term sea-going expedition and laboratory experiments.

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Keywords: shallow gas hydrates, Japan Sea, 2015 coring campaign

Identification of shallow methane hydrate concentrated intervals by LWD within the gas chimney-mound structure, eastern margin of Japan Sea.

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Two LWD, Logging While Drilling, survey cruises were carried out in 2014 and 2015 summer season in the eastern margin of Japan Sea in order to explore the geological characters of the shallow methane gas hydrate within the gas chimney-mound structure, which is well developed in this area. 2014 summer cruise hires natural gamma ray, resistivity, sonic and CMR loggings. Clear anomalies of low natural gamma, high resistivity, high sonic velocity, low NMR porosity were detected at the gas chimney structures in off-Joetsu and Mogami Trough area. Thus, it was interpreted that the methane hydrate concentrated intervals show these anomalies. In 2015, gas chimney structures were explored in more detail with natural gamma ray, resistivity, sonic, CMR and neutron logging tools. The hydrate concentrated intervals were clearly identified with high neutron porosity, low neutron gamma density and low sigma (neutron capture cross section) anomalies in addition to the previously recognized logging anomalies. We will report the detailed methane hydrate distribution within the gas chimney-mound structure according with the correlation of LWD and coring results.
This study was conducted as a part of the shallow methane hydrate exploration project of METI. We express sincere thanks to Mr. Tetsuya Fujii, Mr. Tokujiro Takayama, Mr. Takashi Kotera, JOGMEC and Dr. Shusaku Goto, AIST, for their support and advices.

Keywords: shallow methane hydrate, gas chimney mound structure, Logging While Drilling

High-resolution 3-D seismic survey (HR3D) of gas chimney structures off Joetsu, Niigata Prefecture

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In the summer of 2015, a high resolution three-dimensional seismic survey (HR3D) was carried out off Joetsu, Niigata Prefecture, to delineate the detailed structure of the gas chimneys which are widely distributed in the area off Joetsu.
In the sections of sub-bottom profiler (SBP), the gas chimneys are characterized by blanking which makes the inner structure of the chimneys invisible. This could be caused by high reflectivity materials existing in shallow layers near the sea floor and the seismic energy could not penetrate to deeper layers. This brings difficulties in tracking of the shallow gas hydrates and BSR as well as formation boundaries in the gas chimneys.
To image the detailed three-dimensional structure within the gas chimneys and its surrounding areas, an HR3D was planned and conducted with short streamer cables with high-density shot and receiver intervals along with high frequency airgun (GI Gun.)
The results of HR3D is good enough to reveal the fine structure in the gas chimneys which are unclear in the SBP data, even though the resolution is inferior to the SBP. The resolution of HR3D data is much higher than that of the existing large-scale 3D surveys which were carried out for petroleum exploration, even though the penetration is not enough compared to the existing 3D in this area.
The HR3D date, along with loggings and other geological data, will be a very useful tool to investigate the spatial distribution of gas hydrates which were confirmed at the wells drilled on the mounds and in the pockmarks.
This study was conducted as a part of the Shallow Methane Hydrate Exploration Project of METI (FY2015.)

Keywords: high-resolution 3D seismic survey, HR3D, shallow gas hydrate, gas chimney, off Joetsu

Detailed depositional topography in the Toyama Trough revealed by the 7K13 Cruise

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Regional bathymetry and backscatter data were obtained by a multibeam echo sounder and a sub-bottom profiler in the Toyama Trough for estimation of shallow methane hydrate resources during the 7K13 Cruise of R/V Kaiyo-maru No. 7 (Matsumoto et al., 2014). This study reports detailed depositional topography imaged along the upper reach of the Toyama Deep-Sea Channel (TDSC).
Some kinds of bars and terraces were found on the bottom of the TDSC. Bars include point bars, longitudinal bars. Some terraces were formed with translation of the channel. Steps transverse to the channel were associated with pools down channel of the steps.
Large sediment waves develop on the levees on the outer banks of meander bends of the TDSC. Some sediment waves are associated with a large scour on the back slope of the levee, suggesting that they were formed as cyclic steps.
This study uses data obtained by the H25 fiscal year shallow methane hydrate exploration project of METI.

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Type distribution and composed area of “gas chimney structure” around Japan Island

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Distributions of shallow gas hydrates often correlate with “Gas chimney structure”, characterized by well-developed acoustic blanking in the eastern part of Japan Sea. Matsumoto et al. (2015MS) confirmed 971 gas chimneys during the RV MBES & SBP survey in 2013-2014, identified three morphological types (Single, Composite, related with inversion structures) based on the occurrence and distribution pattern. Continuously, 2015 survey was performed from eastern part of Japan Sea to the north Pacific and southern part of the sea of Okhotsk, south of Hokkaido and off Abashiri. This survey was performed in 75 days from May 6th to July 19th. In order to find the existence of “gas chimney structure”, we firstly extracted topographic anomalies from the initial survey based on depth profiles and back-scatter images by MBES (Multi-Beam Echo Sounder) EM302, secondary evaluated the presence of acoustic blanking, “gas chimney structure” from detailed SBP (Sub-Bottom Profiler) TOPAS PS18 survey on the topographic anomalies.
“Gas chimney structures” were identified in all the survey areas from around Oki islands, Toyama trough, Mogami trough, off Nishi-tsugaru, off Okushiri islands, off Hidaka, off Tokachi, and off Abashiri, counting up to 771. The total number of “gas chimney structures” has become 1742 throughout. In this presentation, we introduce the features with morphological types of “gas chimney structure” in each area, focus the number and size distribution.
This research was a part of METI's project entitled “FY2014 Promoting research and development on methane hydrate”.

Reference

Matsumoto et al. (2015MS), Types and distribution of gas chimneys: host structure of shallow gas hydrates, Japan Geoscience Union Meeting 2015.

Keywords: shallow gas hydrate, gas chimney structure, number and size distribution

Recovery and hydrate estimate of gas hydrate bearing sediments by pressure coring tool PCTB and onboard core handling system PCATS

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Multi-hole drilling/coring was conducted on 3 hydrate mounds/gas chimney structures in Oki trough and off Joetsu in August to November, 2015, with an intention to reveal the distribution and amount of shallow gas hydrates in gas chimney structure. On the basis of the results of 2014 drilling campaign, the pressure coring system of Geotek LTD composed of coring tool PCTB and core handling system, PCATS, installed onboard the drill ship. PCTB is designed to recover pressurized gas hydrate bearing sediment cores of 2.5 m long and 5.1cm in diameter, and 2015 campaign recovered 32 PCTB cores with in situ pressure in 42 deployments. Immediately after the core recovery on deck, PCTB cores were transferred to PCATS (Pressure Core Analysis and Transfer System) for transparent X-ray imaging, Gamma-ray density and Vp logs to roughly identify the lithology and occurrence of hydrates. Then, the pressurized cores were cut into 2 to 5 sections for detailed measurements and for shore-based analysis. Quantitative degassing experiments to measure total amount of hydrate gas has provided the precise volume% of hydrate in the section. After degassing, waters of the section were squeezed to measure chloride and sulfate concentration. Chloride concentration of the pristine IW is calculated from hydrate amount (vol%) and measured water chemistry, assuming that the squeezed water is a mixture of pristine IW, hydrate water (Cl and SO4 = zero) and sea water contamination (Cl=559mM, SO4=28.9mM). Cl of the pristine IW provides the baseline to estimate the amount of hydrate in nearby sections and cores from squeezed “IW” waters. We also report the occurrence, micro-texture and estimated amount of gas hydrate in pressure cores. This study was conducted as a part of the shallow methane hydrate exploration project of METI. We express our thanks for allowing us to present this paper.

Keywords: Pressure coring, gas hydrate amount

Concentration anomalies of pore waters collected from shallow gas hydrate deposits in the eastern margin of the Japan Sea

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Massive gas hydrates have been observed around the gas chimney structures, excess gas accumulation is responsible for the rapid formation of gas hydrates near the seafloor. Although the dissociation of gas hydrates results in the dilution of pore water due to the release of fresh water from the hydrate crystals, rapid formation of gas hydrates can enclose saline pore waters excluded from the crystals. The in situ pore water geochemistry in the subseafloor environments in the gas hydrate area reflects the dynamic history of formation/dissociation of gas hydrates. We have conducted geochemical analyses of pore waters collected from the shallow gas hydrate occurrences along the eastern margin of the Japan Sea during the PS15 expedition in order to show the geochemical models of shallow gas hydrate formation system.
Although concentrations of chloride dissolved in pore waters are close to the seawater of ~560 mM at the sites where no or small amount of gas hydrates accumulates, those at the dense massive gas hydrate sites are often increased; reaching >1400 mM in the highly gas hydrate accumulated intervals. These high chloride intervals locate in shallower depths at the higher methane flux sites. Our results indicate that the pore water geochemistry is often modified in response to the formation dynamics of massive gas hydrates near the seafloor.
This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: Shallow gas hydrate, Pore water

Comparing physical properties of the sediments in the Japan Sea

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In 21 century, most of the methane hydrates distributed in the Japan Sea are by an outer layer type, and it is interpreted that developing in dozens of meters from the seabed of the mound with the gas chimney structure in a recent study (Matsumoto at. al.2014). Because the outer layer type methane hydrates are different from the depths type of the Nankai trough in many respects, we should prepare the new development scheme when producing tests in future. Therefore, this study focuses on the behavior of the sediment physics on the methane hydrate accumulations, and influence of the seafloor environment. When we would take methane hydrate near the seafloor, not only we are concerned about degradation of the seabed environment, but also we are apprehension about the ground sinking by the machine built and the effect of foundation pile exchanging to the poor subsoil by the degradation. On the other hand, it is essential to grasp stress of sediment of the depth profiling by examining the ground strength every depth because various work in the collection of the hydrate is performed in the deep layer.
Therefore, we had geotechnical tests, such as Vane share strength tests, Cone penetrate tests, and Water content tests, at the reference sites around the Oki and the Jyoetsu offing. In addition to study mechanical tests, we compared with MD179 results. This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: The Japan Sea, sediments, physical properties

Cone penetration tests at shallow gas hydrate exploration sites in 2015

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To develop a production method for natural gas from shallow gas hydrate accumulations, the mechanical strength of shallow sedimentary layers should be investigated. During shallow gas hydrate exploration in 2015, cone penetration tests were conducted at test sites off Joetsu, Japan. The cone penetration resistance, sleeve friction, and pore pressure were measured by using a piezocone penetrometer testing (PCPT) apparatus supplied by Geoquip Marine. The effective section of the cone was 10 cm^2. The penetration rate and the stroke of the PCPT were 2 cm/s and 3 m, respectively. The cone penetration resistance was less than 100 MPa. The data measured by the penetrating cone were transmitted to an onboard display and a recording device in real time. An undisturbed specimen 1 m long was also sampled immediately above and below the PCPT trial zones, and vane shear and undrained triaxial tests were performed. Because test wells for PCPT were drilled at sites near coring wells, the PCPT results were compared with descriptions of the core specimens. The comparisons confirmed that the PCPT responded sensitively to thin sandy layers, granular gas hydrates, and carbonates in a muddy zone. Undrained shear strengths was also estimated from the PCPT results by using a relational expression for subsurface exploration on land. The estimated values of undrained shear strength were similar to those of the undrained shear strengths measured by the triaxial tests on the undisturbed specimen sampled near the PCPT trial zones. By using the estimated undrained shear strength values, the depth profiles were compared.
This study was conducted as part of the shallow methane hydrate exploration project of the Ministry of Economy, Trade and Industry (METI), Japan.

Keywords: Shallow gas hydrate, Piezocone penetrometer testing, Undrained shear strength

A working hypothesis on the accumulation of methane hydrate in gas chimneys developed in the eastern margin of Japan Sea

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A lot of gas chimney structures are identified by a sub-bottom profiler as acoustic blanking in the eastern margin of Japan Sea. The acoustic blanking is caused by hard stuff such as carbonate nodules and gas hydrate that develop usually on the seafloor or very shallow depths. Therefore, the deeper part of the acoustic blanking or gas chimney structure was remained unknown. The coring of gas chimney structure of three topographic highs by R/V Hakurei in 2014 clarified that gas hydrate occur from the surface to the deep in the gas chimneys.
A series of observation of the recovered cores by necked eyes, X-ray CT photography and experiments such as sieving of carbonate nodules from mud clarified the close association of carbonate nodules and gas hydrate in the sediments of gas chimneys. This combination of carbonate nodules and gas hydrate occurs periodically and the calculated cycles are around 15 ky.
Preceding studies clarified the following subjects.
1. Carbonate nodules in the gas hydrate field of Japan Sea are interpreted to be formed in the sulfate-methane interface (SMI).
2. The carbon and oxygen isotopic ratios of the carbonate nodules demonstrated the thermogenic methane from the deep largely contributes the formation of the nodules.
3. Active faults and folds develop in the mobile belt of the eastern margin of Japan Sea and form many topographic highs.
Combining the above-mentioned preceding studies and acquired data, we propose the following working hypothesis: Methane gas has been periodically supplied from the depth by the movements of active faults, and the gas repeatedly formed both carbonate nodules and methane hydrate at around the depth of SMI that existed at or in the shallow depth of the seafloor.
Further studies are required if the proposed mechanism of the accumulation of shallow gas hydrate would be applied generally to the other gas hydrate-bearing topographic highs that distribute in the eastern margin of Japan Sea.
We express sincere gratitude to all the persons in JOGMEC who engaged to operate R/V Hakurei in 2014. X-ray CT photos of cored samples are taken under the cooperation program between Kochi Core Center and Akihiro Hiruta (14B013). This research is a part of the shallow methane hydrate exploration project of METI.

Keywords: shallow methane hydrate, carbonate nodule, Japan Sea, drilling, active fault

A rock paleomagnetic study of marine sediments in gas hydrate area of the eastern marging of Japan Sea

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We conducted a rock magnetic study of marine core sediments to clarify relation between shallow gas hydrate and around the sediments.The core samples were taken from around Oki area and off Joetsu, Japan Sea, during PS15 cruise in 2015. We mainly report magnetic susceptibility measurement of whole-round core samples.
This study was conducted as a part of the shallow methane

Keywords: Shallow gas hydrate, Rockmagnetism, marine sediments, Japan Sea

Estimation of shallow gas hydrate formation age by methanol analysis in the gas hydrates

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Natural gas hydrate, an inclusion compound of natural gas in water cages, is found in deep-sea sediments and permafrost region. In eastern margin of Japan Sea, shallow gas hydrates have been found and recovered by piston coring (Matsumoto et al., 2011; Lu et al., 2011). We have an interest on formation age of the shallow gas hydrates. In our previous study, methanol and formaldehyde might be formed by natural radiation and accumulated in the gas hydrates. It indicates that the concentration of these volatile organic compounds is related to the formation age. Previous measurements of methanol in shallow gas hydrates recovered by piston coring showed that it was difficult to discuss the formation age because the gas hydrate samples were recovered from a few meter below the sea floor and the expected amount of methanol formation by natural radiation was too small. In this study, gas hydrate recovered from much deeper region was sampled in 2015 expedition. Methanol in the hydrate together with pore water samples were analyzed by gas chromatography mass spectrometer (GC/MS). The small amount of methanol was detected even in the deeper gas hydrate samples (from ~100 meter below sea floor). The interpretation will be discussed, considering the sedimentation rate. This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: shallow gas hydrates, formation age, methanol, gas chromatography, natural radiation

Atmospheric gas concentration anomalies in the ocean: A preliminary report from a shallow gas hydrate exploration project

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We could often notice the gas plumes rising from a seafloor water column at gas hydrate fields. Active gas vents at the seafloor have previously been reported by some researchers. Methane (CH_4) is a major constituent of seep gases. Methane is an important short-lived climate pollutant. It is reported that oil spill at sea bottom and offshore oil/gas platforms affect atmospheric CH_4 concentration. Likewise gas seeps may contribute to atmospheric gas concentration above the sea surface. Our objectives were to investigate the distribution of atmospheric CH_4 distribution over the sea surface of gas hydrate areas by continuous measurement on a research vessel.
We took advantage of topographical survey (7K14, 7K15) for grasping the resources of shallow gas hydrate and for continuously measuring CH_4 concentration. We used the R/V Kaiyo-Maru No.7 (Kaiyo Engineering Co., Ltd., Japan) from April to June 2014 and from May to July 2015. Continuous measurement of atmospheric CH_4 was performed on the ship using a wave-length-scanned cavity ring-down spectrometer (WS-CRDS) (model G2201-i, Picarro Inc., USA). Air sample was collected from an air inlet installed at the compass deck (approximately 8 m above the sea level) of the ship using an air pump placed in an observation room. The ship sailed at approximately 6 knot during the survey periods. Ship-s location data were obtained with a nautical GPS.
There were 2 types of sea areas: (1) areas with gas plumes observed, and (2) areas with no gas plumes observed. Additionally, gas plumes were unevenly distributed in the gas plume area. In some of gas plume areas, the anomalies of CH_4 concentration were coincidently observed around above gas plumes. Atmospheric gas concentration affected by sea water temperature, water depth, and scale of gas plume varied every different sea areas.
This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: gas hydrate, Methane gas, gas plume

Shallow methane hydrate outcrops discovered through ROV submersible survey in the Japan Sea

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In the Japan Sea, several outcrops of methane hydrate were discovered through ROV (Remotely Operated Vehicle) submersible survey. Occurrences of the outcropping methane hydrates and their surrounding topographies are described using submersible videos and still images. This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: shallow methane hydrate, ROV, Japan Sea

Preliminary account of benthic habitat mapping on shallow gas hydrate areas on the eastern margin of Japan Sea.

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This study presents results of an approach for sea floor habitat mapping based on an integrated analysis of multibeam bathymetric data, associated geoscientific information, and benthos data from shallow gas hydrate areas on the eastern margin of Japan Sea.
Six areas, SW of Oki trough, SE margin of Oki trough, Northern Torigakubi spur, off SW of Sado, off Hajikizaki and NE of Torimiguri were investigated. The number of individuals of macrobenthos taken a picture of to the high-definition television camera of ROV "Hyper dolphin" was done and several in total was done at ten seconds in which the position of ROV was recorded. The bottom sediment was recorded at the same time, and the relation between the benthos distribution and the bottom sediment was examined. In addition, the positional data of ROV, the bottom sediment, and the benthos distribution were input to GIS, it reflected in the bathymetric chart, the habitat map was made, and the benthos distribution and the seafloor condition in each area were compared.
This study was conducted as a part of the shallow methane hydrate exploration project of METI.

Keywords: shallow gas hydrate, habitat mapping, benthos

